

J. Jackson Harper, P.G.
Geological & Hydrogeological Consulting

31 August 2010

Mr. Shaun Cranston
Carma Developers, L.P.
9737 Great Hills Trail, Ste. 260
Austin, Texas 78759

Project No. 07018

Re: Hydrogeological Issues
Paso Robles Project, San Marcos, Texas

Dear Mr. Cranston:

This letter is intended to address some of the concerns about the Paso Robles project which have been voiced by Ms. Dianne Wassenich of the San Marcos River Foundation (SMRF). Ms. Wassenich, SMRF, and others are clearly concerned about potential negative impacts that the project will have on the quality of water in the Edwards aquifer (and ultimately the San Marcos River). This is understandable, given the Edwards aquifer's overall vulnerability to pollutants. Indeed, the sensitivity and importance of the aquifer have led to the creation of a significant body of federal, state, county, and municipal rules and ordinances intended to protect it and (by extension) humans and other species.

I was contracted to conduct a geologic assessment of the Paso Robles project site in compliance with the City of San Marcos (COSM) Land Development Code and the Edwards aquifer rules enforced by the Texas Commission on Environmental Quality (TCEQ). Generally, these regulatory programs require examining prospective development sites for natural and manmade features that potential pathways for water to enter the Edwards aquifer. Features that are determined to be sensitive recharge features are required to be protected to maintain the quantity and quality of ground water recharge.

Among other concerns, SMRF has expressed doubt that the geologic assessment of the Paso Robles site is credible and that its findings may intentionally favor the project owner's interests. On the assumption that you will be sharing this letter with others unfamiliar with my work, I would like to summarize my credentials for conducting the geologic assessment and responding to issues that have been raised.

I received a Bachelor of Science degree in Geology in 1975 and have practiced in the specialized areas of environmental geology, ground water hydrology, and engineering geology continuously since. I was employed by the Mississippi Geological Survey for four years, a large multidisciplinary engineering and environmental consulting firm in Austin, Texas for 23 years, and have practiced independently for the past eight years. I have been a Texas-licensed professional geoscientist (#No. 069) since licensing began in Texas in 2002. I am also a registered professional geologist in three other states. Over the years, my clients have included public and quasi-public agencies (e.g., TNRCC - predecessor to TCEQ, Lower Colorado River Authority, City of Austin, City of Austin, U.S. Forest Service), electric utilities, mining companies, waste management companies, industrial manufacturers, petrochemical companies, water supply companies, and land developers. Paso Robles is the first project I have completed for Carma Developers. I began conducting geologic assessments in central Texas pursuant to the Edwards aquifer

rules in approximately 1990, and they have constituted a moderate to significant part of my practice since 2002. My work experience includes analyzing and quantifying the transport and fate of organic and inorganic contaminants in porous and fractured aquifers.

In addition to reviewing published and other background information on local geologic and ground water conditions, approximately 80 person-hours were spent walking the Paso Robles site to identify potential recharge features. A total of 34 natural and manmade features (e.g., impoundments, wells, caves, sinkholes, faults, etc.) were identified and evaluated. Seventeen were determined to be sensitive features. Eight of those were water wells that will be plugged or modified as needed to prevent contaminants from entering the aquifer via the well bore or casing. Six features will have buffer zones established around them to prevent contaminants from enter the features via surface runoff. The remaining features include portions of faults along stream channels which will be protected by COSM water quality zones that border the drainages. All buffer zones are intended to meet or exceed the requirements of TCEQ and COSM.

It is worth noting that TCEQ has reviewed and approved the geologic assessment, and I believe the Edwards Aquifer Authority (EAA) and COSM have had the opportunity to comment on the report. I expect that further discussions will take place with COSM staff. Lastly, there is a continuing requirement to identify and mitigate any sensitive recharge features encountered during subsequent development of the project site.

The reminder of this letter addresses some specific issues raised by SMRF and others concerning the hydrogeology of the project site and possible ground water impacts of the project. I certainly do not mean to misstate, over generalize, or trivialize any concern, but for the sake of time and brevity, I have paraphrased each concern and followed it with a short response. I would be pleased to discuss any issue in more detail.

- *Reclaimed water (i.e. treated COSM municipal wastewater) will be used to irrigate the Paso Robles golf course. The water contains wastewater nutrients and pharmaceuticals that will contaminate the Edwards aquifer, drinking water wells, and harm aquatic species such as the endangered salamanders.*

Tom Taggart (COSM Water-Wastewater Utility Director) presented information at a P&Z hearing indicating that analysis of the city's wastewater for a set of common pharmaceutical compounds showed that treatment at the wastewater plant removes essentially all conventional pollutants (including nutrients) and nearly all (all but one?) of the tested pharmaceuticals. While I have not seen the test results, my impression is that the residual pharmaceuticals are present at very low (i.e., parts per trillion) concentrations. Much of the research conducted over the past decade has looked at instances where such compounds occurred at higher concentrations (i.e., parts per billion or million) where environmental impacts were more apparent. At lower concentration, such compounds may pose considerably less or no significant health risk.

- *The Edwards aquifer recharge zone is where only bedrock is exposed. All or most precipitation on the outcrop and surface runoff that drains onto the recharge zone, infiltrates the bedrock, and rapidly reaches the ground water table. So, contaminants associated with golf course irrigation and turf maintenance would penetrate the aquifer quickly and go into the immediate neighbors' wells, and of course would also quickly affect the city well, Crystal Clear wells and the wells used by the Marcos National Fish Hatchery & Technology Center (i.e., refugium).*

This is a generalization that mischaracterizes the nature of the recharge zone. Soils on the recharge zone tend to clayey (relatively low permeability) and can be very thin to absent, but can also be two feet thick or more. Recharge occurs primarily at discrete points (e.g., sinkholes, caves, open fractures). In hilly areas some of the water that infiltrates the ground reemerges downslope as seeps and becomes surface runoff. It has been estimated that only 15-20 percent of the aquifer's recharge occurs in upland areas. Further, it is certainly untrue that all water on the recharge zone becomes recharge.

While additional recharge features may be found at the site, the geologic assessment was thorough, and plans have been formulated to protect all sensitive recharge features that were identified. Lastly, the last land plan I looked at indicated that all of the recharge features found at the site would not be in golf course fairways, greens, etc. In addition, I understand that golf course operation and maintenance will adhere to the Audubon International Signature program which calls for the uses organic fertilizers and pesticides.

- *The Edwards aquifer transition zone is just Edwards limestone which is the holey karst rock with lots of cracks and openings, the very same rock that is exposed at the top of the ground in the recharge zone. But the rock on the transition zone is buried under soil which can be six inches thick or several feet thick. This soil will be bladed up during the construction, and if an expert is not there to see what is exposed during blading, then no one will know that an opening has been created that will take runoff and chemicals directly to the aquifer, just as though this is recharge zone land.*

The transition zone is generally southeast of the recharge zone. In this area, the Edwards aquifer is covered (overlain) by generally low permeability rock and clay strata plus whatever surface soil has formed on the strata. At the project site, there is a 50- to 100-ft thickness of clay and rock strata separating ground surface from the underlying aquifer.

- *The Edwards aquifer contributing zone occupies a large part of the project site. Surface runoff from the contributing zone will contain wastewater nutrients and pharmaceuticals, as well as the pesticides and other chemicals, and the runoff will be directed to the recharge zone. Even if the small amount of golf course within the recharge zone was lined and treated wastewater was banned from the recharge zone, the contributing zone would be sending a big stream of all these collected chemicals toward the recharge zone outside the Paso Robles border, where there would be no liner.*

The contributing zone is underlain by relatively low permeability limestone and clayey strata and a high proportion of the precipitation (or irrigation water) on the contributing zone could drain to the recharge zone on or off the project site. While I am not involved in the design of the golf course, in my understanding the project engineer is investigating ways in which runoff from the course can be controlled. This could include grading to ensure runoff is captured and recirculated through ponds. Also, irrigation rates could be managed so as not to exceed plant uptake and soil evapotranspiration rates.

Lastly, at least one study in the scientific literature discusses the high degree of attenuation (fixation) of many pharmaceutical compounds in irrigation water used in a few inches of soil at a golf course in the southwestern U.S. The engineering of a suitable soil horizon at the golf course might provide a means of controlling contaminants that may exist in the reclaimed water used for irrigation.

- *Recent articles in the San Antonio paper about the plume of aquifer pollution from an old Air Force base there, had very sad stories about the health effects of those whose wells were contaminated for*

Mr. Shaun Cranston
31 August 2010
Page 4

decades without the residents knowing. Many of those people died, while they fought for years to draw attention to the pollution issue. Sewage spills on the recharge zone in San Antonio have resulted in e.coli contaminating the Edwards aquifer. This is a real problem, and you do not want to be in the middle of a controversy like that, with serious health problems caused for your residents.

Contamination of the aquifer that was attributable to Air Force activities were the result of many years of military and industrial-type activities (e.g., airport jet storage and handling) completely different from the residential use planned at Paso Robles. Comparing such cases to the Paso Robles project is probably not valid.

If you have any further questions, please feel free to contact me.

Yours truly,


J. Jackson Harper, P.G.